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The Supernova Equation of State: Potential vs. Field-Theoretical Approaches CONSTANTINOS CONSTANTINOU, SUNY Stony Brook & Ohio University — An important ingredient in simulations of core collapse supernova explosions is the equation of state of nucleonic matter for densities extending from 10^{-7} fm^{-3} to 1 fm^{-3}, temperatures up to 50 MeV, and proton-to-baryon fraction in the range 0 to 1/2. In this work we study supernova matter using a non-relativistic potential model as well as a relativistic mean-field theoretical one. In the former approach, we employ the Skyrme-like Hamiltonian density of Akmal, Pandharipande, and Ravenhall which takes into account the long scattering lengths of nucleons that determine the low density characteristics. In the latter, we use a Walecka-like Lagrangian density supplemented by non-linear interactions involving σ, ω, and ρ meson exchanges, calibrated so that known properties of nuclear matter are reproduced. We focus, initially, on the bulk homogeneous phase and calculate its thermodynamic properties as functions of baryon density, temperature, and proton-to-baryon ratio. The exact results are then compared to approximate ones in the degenerate and non-degenerate limits for which analytical formulae have been derived. Our next step would be to extend our calculations of the state variables to the subnuclear region in which nuclei are present.

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